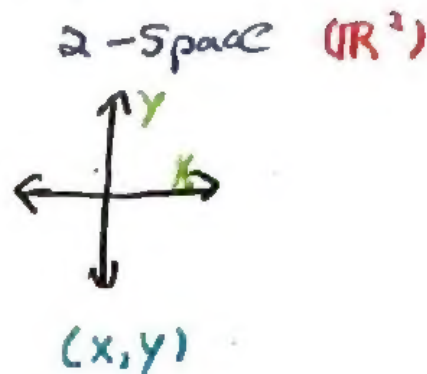
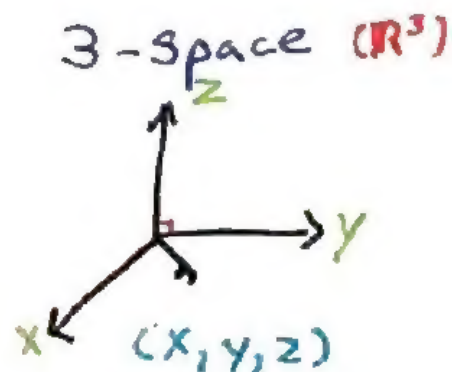


12.1 Coordinate in 3-Space



\in
"in"
:
"such that"

I. Coordinate Planes

A coordinate plane is the set of pts. in which a specified pt. is O (

Ex. The xy -plane (also the $z=0$) in \mathbb{R}^3 is $\Pi = \{P=(x, y, z) \in \mathbb{R}^3 : z=0\}$,
 y - z -plane in \mathbb{R}^3 $\{P=(x, y, z) \in \mathbb{R}^3 : x=0\}$, x - z -plane in \mathbb{R}^3 $\{P=(x, y, z) \in \mathbb{R}^3 : y=0\}$

Aside: Distances



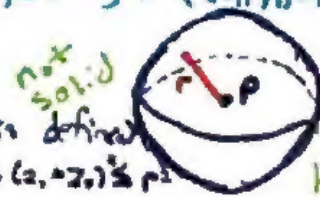
$$d(P, Q) = \sqrt{(x_1 - x_0)^2 + (y_1 - y_0)^2 + (z_1 - z_0)^2}$$

← The Distance Formula (\mathbb{R}^3)

II Spheres

Let $r > 0$ and let $P \in \mathbb{R}^3$. The sphere of radius centered at P is $S = \{Q \in \mathbb{R}^3 : d(P, Q) = r\}$

If P has coordinates $P = (x_0, y_0, z_0)$, then $S = \{Q \in \mathbb{R}^3 : d(P, Q) = r\} = \{(x_1, y_1, z_1) \in \mathbb{R}^3 : \sqrt{(x_1 - x_0)^2 + (y_1 - y_0)^2 + (z_1 - z_0)^2} = r\}$
 $= \{(x_1, y_1, z_1) \in \mathbb{R}^3 : (x_1 - x_0)^2 + (y_1 - y_0)^2 + (z_1 - z_0)^2 = r^2\}$



NB: spheres are "surface" of a hollow ball

NB: everything we've done so far has analogues solid ball is defined in higher dimensions. E.g., there is \mathbb{R}^4 by $(x_1 - x_0)^2 + (y_1 - y_0)^2 + (z_1 - z_0)^2 + (w_1 - w_0)^2 \leq r^2$ w/ a distance formula $\{P(x, y, z, w) : x, y, z, w \in \mathbb{R}\}$

$$d(P, Q) = \sqrt{(x_1 - x_0)^2 + (y_1 - y_0)^2 + (z_1 - z_0)^2 + (w_1 - w_0)^2}$$

12.2: Vectors

Def: A vector in \mathbb{R}^3 is a directed line segment, where two vectors are equivalent when they are linear shifts

